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BY

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LONDON:

JOHN CHURCHILL & SONS, NEW BURLINGTON STREET.

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1869.



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IN the endeavour to give to the study of infantile disorders, a certainty approximating to that which we bring to the investigation of the diseases of adults, exact observations were wanting, not only in the temperature changes of the earliest period of infancy, but even in the ordinary variations of the pulse and respiration. To supply this want, more felt when the patients cannot give an account of their ailments, is attempted in the first part of the present paper.

The temperature of the infant at birth is that of the mother, so that generally it will be about  $99^{\circ}$ . Taking the two extremes of temperature at birth, where the mother's temperature has exceeded  $100^{\circ}$  the child's has also; and once, when the temperature of the mother was as low as  $98^{\circ}$ , so was that of the child. In these cases, as in several of the more ordinary instances, special means were taken to ascertain this correspondence by inserting a thermometer of small bulb and long index within the spincter ani of the child immediately after birth. This same thermometer has been made use of in all the subsequent observations.

The point of interest next to be noticed is the uniformity with which the infant acquires that particular degree of temperature ( $98\frac{1}{2}^{\circ}$  to  $99^{\circ}$ ) which is to become the index of the health of the individual, literally from the cradle to the grave.

To take an ordinary instance: (Case 1) a boy born quite at

the full period without undue difficulty at 1.30 p.m., the temperature taken in the rectum at 2 o'clock, was  $98^{\circ}4$ , the child having been but slightly covered in a not very warm room; the surface generally was colder, but at 3 o'clock after the child had been washed and dressed,  $98^{\circ}4$  was easily obtainable in the folds of integument at the neck. At 8 p.m. the temperature taken at the neck was still  $98^{\circ}4$ , and next morning the same, though the night had been passed sleeping in a bassinet; little or no food had been taken as the child seemed too well nourished to have much disposition to suck. At 11 a.m., after washing and dressing, the surface temperature in the neck was  $98^{\circ}8$ . During the month the supply of breast milk had to be supplemented by the bottle, but the temperature was always found close upon  $98^{\circ}4$ . The child was weaned in the second month, and after some variations the temperatures taken during a week were all nearly the same.

Of two children born prematurely, both at the period of eight months, the one, a boy (Case 2), twelve hours after birth had a temperature of  $98^{\circ}7$ , very nearly what it was at birth; the next day the rectal temperature was  $99^{\circ}$ , though only a little water and sugar of milk had been given; a wet-nurse was then obtained, and after some irregularity at first, the temperature for several days continued between  $98\frac{1}{2}^{\circ}$  and  $99^{\circ}$ : the other, a girl (Case 3), having the extreme of high temperature at birth, was considerably below the average on the second and third days after; on the fifth and sixth days there was a temperature of  $98^{\circ}$ , though the advantage of suitable nourishment was wanting.

The extreme instance of low temperature at birth (Case 4) was a girl, supposed to be beyond the full period, and certainly of full size; the cord was in a tight knot, and some little time elapsed before respiration was perfectly established; six hours after birth the temperature *in recto* was still  $98^{\circ}$ , the surface had become warm and of good colour, nothing had been swallowed and no urine passed; next day there was a rise of half a degree; after that, the supply of breast-milk being very free,  $99^{\circ}$  was always obtainable, whether the child were

close to the mother's side in a greater heat than seemed wholesome, or exposed in washing and dressing to a lower temperature, and for a much longer time than seemed prudent.

The diurnal variation of temperature, which becomes the rule of later life, is hardly to be observed in young infants; their sleep comes as readily in the day as in the night, and their food is often as easily within reach in the night as in the day. A somewhat higher temperature is found in the latter part of the day by the fourth or fifth month, but even then a great difference between the morning and evening temperature would indicate want of attention on the part of the nurse, or delicacy of constitution in the child, or both. A marked increase of temperature towards night has been established by Dr. Sidney Ringer as a sign of tuberculosis.

Food is the source of heat, and the equality of temperature in early infancy is mainly dependant upon fitness of food and frequency of feeding. Two hours, or if the infant has been sleeping, three hours may be requisite for a full meal to influence the temperature of a healthy child: thus of three observations taken in the second month, in Case 1, two were taken within an hour of the mid-day meal, giving  $98^{\circ}$  and  $98^{\circ}\cdot2$  in the neck,  $98^{\circ}\cdot6$  in the rectum; the third taken at 3 o'clock was  $99^{\circ}\cdot1$  in the neck, the child had been sleeping since its meal, which was a full one.

The immediate effect of a meal, or of warm liquid merely, in raising the temperature of the body, as pointed out by the late Mr. Stuart, has been too generally stated; it has rarely been noticeable here, probably because of the care taken to avoid giving infants their food too hot: once this was allowed with the following result. In the case just given (Case 1) the infant when three months old was restless and in some pain; the diet being equal parts of milk and water, some curd passed undigested; the child had been recently crying much, the temperature was  $98^{\circ}\cdot2$  in the rectum, and until the descent of some faecal matter was only  $98^{\circ}$ . Four ounces of thin, sweet liquid at a temperature of  $101^{\circ}$  was given in a tube bottle, the half of this was taken while the temperature was near  $100^{\circ}$ , and most of it while above  $99^{\circ}$ . In a quarter of an hour the



rectum temperature reached  $99^{\circ}\cdot4$  during the passage of a considerable quantity of liquid faeces, in another quarter of an hour the temperature in the rectum was still  $99^{\circ}$ .<sup>1</sup>

When the child has suffered weakness or want, a direct increase in the bodily temperature follows the administration of food. Thus, in Case 2, before noon on the fourth day, the child neither having been washed that morning nor fed for some hours, the surface temperature was  $97^{\circ}$ , and that *in recto* only  $97^{\circ}\cdot4$ ; after suckling the temperature quickly rose to  $98^{\circ}$ : the next day it was  $98^{\circ}\cdot4$ . Also, in Case 3, when the child not being suckled for the first three weeks had thrush and was in danger of death from inanition, the debility was too extreme when the child was put to the breast for an immediate effect to be produced by the new food; twice the temperature had been near  $96^{\circ}$ , once even down to  $95^{\circ}$ , and generally not much above  $97^{\circ}$ ; during the first two days of breast-milk the temperature was only  $97^{\circ}$ , it became  $98^{\circ}$  both *in recto* and in the folds of the neck by the evening of the second day, when it was also as readily obtainable at the surface as the interior of the body; there were at the same time other signs of the return to health of the mucous membrane as well as the skin: on the third day the child was washed and dressed after three hours sleep; at 10 a.m., without being nursed, the temperature was  $97^{\circ}\cdot8$  on the surface, and less than  $98^{\circ}$  in the rectum; a full meal was then given, which caused an increase of a whole degree of temperature; before noon, the child sleeping,  $98^{\circ}\cdot8$  was easily obtainable in the folds of skin at the neck.

More frequently the influence of food or of warm liquid is seen in developing upon the surface of the body a temperature already existing within. Cold bathing has a marked effect in this way on the healthy child, and while no stimulant

<sup>1</sup> Adults frequently swallow hot liquids, especially tea, at a temperature over  $130^{\circ}$ . Infants are more judicious; it has been noticed that when, as not infrequently happens, their food has been offered at too high a temperature, they will play with the tube and take but little till the temperature falls. A thermometer placed in the bottle will be at  $99^{\circ}$ , or below, at the time the food is swallowed freely.



is so valuable as food, the influence of the bath in equalizing the temperature of the body ought not to be overlooked; the greatest effect in raising the temperature of the surface is produced by the combined effect of both. Where the circulation is feeble, or there has been fatigue or a chill, warm liquid and external warmth combine best in this object. The effect of food and the bath was noticed in a child of four months (Case 5). On October 1st, at 10 a.m., the temperature in the axilla before breakfast and the bath was only  $97^{\circ}8$ , while in the rectum it was  $99^{\circ}6$ ; a little later in the day the axillary temperature was  $98^{\circ}7$ , that of the rectum  $99^{\circ}1$ : the bowels were confined. So that here not only is the general temperature restored to the surface, but it is equalized, for while that taken in the axilla is raised by nearly a whole degree, that in the rectum is lowered by exactly half a degree. The next day, October 2nd, before washing and feeding, the axillary temperature was  $97^{\circ}$  only, the rectal  $98^{\circ}6$ ; the bowels had become relaxed. On October 3rd, at 10 a.m., after washing and feeding,  $98^{\circ}2$  was easily obtained in the axilla. On October 4th, the evening was chosen for the same enquiry; before having food and being undressed for the night, the temperature was only  $96^{\circ}$  in the neck,  $97^{\circ}$  in the axilla, and  $99^{\circ}$  in the rectum; later in the evening  $98^{\circ}$  was obtainable in the neck while the child was asleep. A similar observation was made upon a strong, thriving girl, three months old, (Case 6) where the natural nourishment was supplemented by the bottle. At 5 p.m. the axillary temperature was  $97^{\circ}4$ , the rectal  $99^{\circ}1$ ; some little gastric irritation had been set up by the use of farinaceous food. Another observation was made in this case some days after all farinaceous food had been discontinued, when  $98^{\circ}$  was obtained in the axilla and  $98^{\circ}3$  in the rectum, but this was earlier in the afternoon, not long after a meal and just after a sleep.

Sleep aids powerfully in maintaining the equilibrium of temperature, its effect is obvious in the above instances: when deficient in the day the temperature keeps up, and though its loss at night has been found associated with a low tem-

perature, yet sleep, if long continued and profound, indirectly tends to lower the heat of the body by its influence upon respiration: thus, Case 3, at two months' old, while wakeful, with a pulse of 150 and respiration 50 in the minute at 4 p.m., had a normal surface temperature and one of  $99^{\circ}$  *in recto*; a day or two after at noon, while in a deep sleep that had lasted two hours, the pulse was 120, the respiration 30 in the minute, and the temperature, below  $98^{\circ}$  in the neck, was only  $98^{\circ}4$  in the rectum.

Respiration has the closest and most important relation to the heat of the body, of which it is the efficient cause; on the establishment of this function an independent temperature is commenced which it continues to maintain and regulate. There is always a certain ratio between the respiration and circulation: at birth the regularity of the fœtal pulse, yielding to the influence of new stimuli, at first becomes greatly accelerated; during sleep it is again down to 120, and may subside to below the fœtal rate during the first two days; the pulse at this time is often as low as 100, but as nourishment becomes more abundant it increases in frequency, and will then frequently be found to be 140 or 150, and the respirations 50 to 60 in the minute.

The respiration varies even more than the pulse; within the first week it has been counted at 80 during one minute and at 40 in the next; shallow breathing may have to be supplemented by yawning, or some imperious want in the economy indicated by crying, an act of great physiological utility. Ordinary quiet respiration in infants has a peculiar rhythm, consisting of a series of fifteen or twenty short pants, with pauses at every quarter or half second, calling to mind the rhythmical contractions of the young jelly fish when separated from the narrow pedicle which held it to the parent polype: there is the same regular action of the newly acquired power and the same short pauses, as if at first fatigue necessitated rest.

Notwithstanding the readiness with which the breathing and pulse vary in infancy under the slightest exciting causes, they maintain a relation to each other which is special to the

early period of infancy, and differs from the ordinary ratio of childhood and adult age; there is also either an innate or readily acquired habitual difference in the rate and ratio of these acts in different individuals. The class difference which demands attention is, first, that in early infancy the ratio of the pulse to the breathing is only *three to one*, it may be even less; and next, when this is steadying down to the more mature ratio of *four to one*, any causes that quicken the rate also increase the ratio. The period to which these signs of infancy-proper may continue, varies; the first, characteristic of the earlier months of infancy may alter at three or four months, or continue beyond the second year; this persistency of the infantile condition is generally associated with debility, and may be traceable from this cause for a year or two longer; the second characterises what is known as the period of dentition, but it has no special dependance upon the appearance of the teeth; it is connected with rapid development, when change is active, the breathing is quickened that the temperature may be maintained.

The normal rate for the first few months of infancy is, pulse 120, respiration 40 in the minute. A child, five months old, (Case 7), while at the breast has a pulse of 104 and respiration 26 in the minute; soon after the pulse becomes 120 and the respiration 40 from some disturbing cause other than the teeth; when this is over, (three weeks from the first observation), the pulse was 100 and the respiration 25 at least during sleep.

It is not until the child is a year, or year and a half old that the formula "pulse 100, respiration 24," which prevails from the second to the seventh year, is generally found, and then with the greatest variations; these depend less upon the state of dentition than upon individual peculiarities, as will be seen: a child of a year old (Case 8) with a pulse of 120 and respiration 30, has this rate somewhat diminished (it was reduced to 88 and 20 on one day from diarrhœa) in the next month while cutting two double teeth; another child (Case 9) of a year and a quarter, with only three incisor teeth, has also pulse 120, respiration 30; of two children, each fourteen



months old, both of rapid growth, the one (Case 10) forward, the other (Case 11) backward with the teeth, each had the pulse 120, and respiration 40; one of these, a boy (Case 10) at a year and a quarter, when all but the last four molar teeth were through, has pulse 100, respiration 24; another boy (Case 12) of two and half years, backward with his teeth, has exactly the same, while a third, (Case 13), two years and eight months old, with all his teeth, but in a low state of nutrition, has a pulse of 120 and respiration of 30. Case 13 and Cases 8 and 11 had a somewhat low temperature; Cases 9 and 10 had high temperatures, which in the first was sometimes, and in the last frequently  $99^{\circ}$ : six months afterwards this child has measles, after which the temperature is low, and the pulse-respiration ratio again becomes 120 and 30 in the minute, and continues so for some weeks.

High temperature and quick respiration are associated with rapid growth. Case 10, at fourteen months, was 33 inches in height; Case 12, up to two years old had the respiration generally 30 in the minute, he had then grown  $2\frac{1}{2}$  inches in less than six months. In this child the respiration while 24 in the day was still 22 during sleep. Other children, two years old, with a respiration of 22 in the day have had it 18 in the night; it has been found as low as 15 at midnight in a boy of seven years old.

The individual differences which in after life may become permanent are less confirmed in infancy if not altogether accidental, thus the infant (Case 5) with a pulse as low as 100 when three days old, had also at three weeks old a pulse of only 110 and a respiration of 30, yet at three months, the temperature being both times  $99^{\circ}$  interiorly, the pulse is 130 and the respiration 40, the difference being from some addition made to the food, which was not over abundant while the child was suckled exclusively; the infant (Case 4) with a superabundance of breast-milk had a pulse of 140 and respiration of 50, the temperature containing from  $98^{\circ}6$  to  $99^{\circ}$ . Only in some of the cases when a frequency of the pulse and respiration has continued through the second year has the infantile rate been also quick. In other cases this

quickness has existed during a few months only, and these times of rapid growth, of which it is indeed a concomitant; and though, as before mentioned, often associated with other conditions, is of itself no indication of pulmonary disorder.

The nervous system probably exercises an influence underlying all these varying conditions, harmonising all the stimuli both from within and without the individual, and tending, as long as its function is unimpaired, to preserve an equability of temperature amid ever changing circumstances. The pulse may vary with the slightest exciting causes, and the respiration with the different states of weakness or want in the body, but the temperature remains the same: the great object seems to be that the elements out of which the phenomena of life are being evolved should be maintained in one constant physical state, of which an even temperature is an important condition. Hence it is that the variations in the bodily temperature become so valuable an indication of disease, in the adult more certain than the variations of the pulse; but in infancy, when the pulse and respiration taken together are even less trustworthy, it is satisfactory to find one condition of the body remaining so far constant (varying only within certain limits, and with certain ascertainable changes in the system), as to be a guide both in our estimate of health, and in our diagnosis of disease.

The extremes of temperature coexist with lesions of the nervous system. Concussion of the brain and shock are associated with exceptionally low temperature. Dr. Hermann Weber<sup>1</sup> has recently shown the connection of certain diseases of the brain with great elevation of temperature, and adduces a case from Sir Benjamin Brodie where this was occasioned by injury to the medulla oblongata. I am indebted to Dr. J. Russell Reynolds for an instance in which, from an injury of the lower part of the spinal cord and complete paraplegia, the temperature of the paralysed parts was considerably above that of the rest of the body. Under my observation exceptionally low temperature occurred in a

<sup>1</sup> 'Transactions of the Clinical Society,' vol. i, p. 21.

case of puerperal convulsions, and exceptionally high temperature in a condition bordering upon puerperal mania.<sup>1</sup> So in infants there are certain convulsive disorders with diminution of temperature as their diagnostic mark—laryngismus stridulus for example. There are others which happen only with great elevations of temperature, such as those which mark the ingress and culmination of some of the exanthemata, where the occurrence of convulsions in infancy shews a certain parallel to, if it does not replace the delirium of older persons and children.

The close relation of nervous phenomena to temperature has an extended significance. Where the nervous centres are themselves the seat of disease it is to be apprehended that a fallacy may arise in the temperature variations ordinarily met with. From two or three cases that have come under my notice, it seems questionable whether pressure from tubercle or other causes may not, at a certain point, either prevent the temperature variation proper to tuberculosis, or interfere with the rise of temperature that would otherwise be occasioned. One of these cases, an adult, characterised by a low temperature throughout, had cancerous tumour of the cerebrum.

The case of paraplegia mentioned above is one of the few in which part of the body has its temperature raised without a corresponding elevation in the general temperature; lesion of the sympathetic, arresting its power to cause contraction of the blood-vessels was doubtless concerned in the high temperature of the lower extremities in this case, where there was also rapid ulceration of the integument. Exhaustion of the nervous supply of a part affected with inflammation or suppuration of long standing, may be the cause of the temperature often being found to be considerably greater there than in the corresponding part of the body, and sometimes probably in excess of that of the interior.

<sup>1</sup> Obstetrical Society's 'Transactions,' vol. ix, p. 129, convulsions preceded delivery in Case 12. In Case 11, besides insomnolency, there were periods of temporary excitement, with delusions.



The greatest difference between a local and general temperature met with in infancy has not exceeded half a degree, and this under exceptional circumstances. An infant, a fortnight old, on the tenth day after vaccination had secondary pustules on the arm, which kept up much irritation and discharge, the general temperature, fluctuating at this time from a little below  $98^{\circ}$  to nearly  $99^{\circ}$ , was easily depressed by exposure, or raised by food; during five days, while the arm was still red and secreting a good deal of thin matter, the temperature in the axilla of the arm affected was higher than that of the rectum, when this was  $97^{\circ}8$  that was  $98^{\circ}3$ ; and after food, while it was  $98^{\circ}8$  in the axilla it was  $98^{\circ}3$  in the rectum; the descent of the fæces reduced, but did not obviate this discrepancy.

There is a lowering of temperature after all the acute febrile diseases, and a liability of it to be easily depressed during convalescence; this has been pointed out by Dr. Ringer<sup>1</sup> and is owing to the interference with nutrition, as well as the waste of tissue thus occasioned: only those who follow temperature variations carefully can be sufficiently impressed with this truth; it obtains in the slighter ailments of children as well as in the more severe. It is well marked after vaccination, and even after a day or two of infantile diarrhœa. In one such case, occasioned by excess or error in feeding, and not treated by medicine, though the temperature *in recto* never exceeded  $99^{\circ}$ , there was a lower range of temperature than usual for five days after, with only  $98^{\circ}$  *in recto* on one of them.

A depression of temperature in infancy is of more immediate practical significance than the slighter elevations, for while it excludes the idea of any acute or special disease existing, it points at once to the condition requiring remedy, namely bad nutrition. This may occur while the infant is being suckled if the milk be deficient in nutritious quality, as well as in Case 3, when from absence of breast-milk the temperature, once as low as  $95^{\circ}$ , was kept down to  $97^{\circ}$ . Even in older children when suckled for too long a period,

<sup>1</sup> Reynolds' 'System of Medicine,' vol. i, p. 416.

or when oatmeal or slops, on the Scotch and French plans, are substituted for milk and bread and butter, the same thing happens: a girl, aged one year and eight months, brought up on the latter plan, has eczema of head with extensive suppuration of the lymphatic glands of the neck; the temperature nowhere was above  $97^{\circ}$ . This child had twelve teeth, and some little trouble from them.

The irritation of teething may have some positive effect in diminishing temperature; this has been found to be low even when there was restlessness at night with a feeling of heat on the head and skin. Flatulence in young infants is a frequent cause of disturbed rest and low temperature. Spasmodic affections, tooth-rash, bronchial râles, and diarrhœa if from tooth irritation and defective nutrition combined, are found associated with a low degree of temperature. During dentition, croupy attacks closely resembling true croup in all external characters, may thus be at once distinguished and relieved.

In cases of so-called "irritation from teething" when the temperature is much elevated, and this may happen in those suffering from the most defective nutrition, some other cause than mere tooth irritation must be looked for; in this way constipation, catarrh, either of pulmonary or gastric mucous membrane, enlarged cervical glands, slight enlargement of the glandulæ concatenatæ, or even otitis may be found; and in these states of system, with great mobility of nervous system, a very high temperature is quickly reached,  $100^{\circ}$  to  $101^{\circ}$  (Case 14) is frequently met with,  $102.3^{\circ}$  (Case 14) has occurred, and even  $103^{\circ}$ ; though this quickly subside, and the complication present call for no grave prognosis, it is to be borne in mind that the high temperature if not enough to cause convulsions, may through exposure or want of care readily lead to some serious complication; indeed, such elevation of temperature as significantly points to the necessity for rest in bed, as does the opposite condition to the improvement of the diet.

In infantile diarrhœa, the temperature taken in the rectum is a valuable aid both to diagnosis and treatment. A child,

(Case 16) fourteen months old, with sudden diarrhœa and thirst, cutting the lower molars, pulse 100, respiration 20, has a rectal temperature of only  $98^{\circ}$ . In Case 8, though the skin felt hot, and the anus was excoriated from the diarrhœa, the temperature in recto was  $98^{\circ}6$ ; a little girl, ten months old (Case 17) cutting the lower incisors, has diarrhœa in the morning and cough at night, pulse 140, respiration 40, has the temperature in recto  $98^{\circ}3$ . A child, six months old, (Case 18) from improper feeding, has severe diarrhœa for three or four days, the rectal temperature continues at  $99^{\circ}$ , once only being  $99^{\circ}3$ . Contrasting strongly with these is Case 19, occurring at the same time as the last, in the summer, the child four months old has diarrhœa, not so severe apparently at first, but the rectal temperature was  $102^{\circ}5$ , and all the characters of choleraic diarrhœa eventually declared themselves; on the fifth and sixth days the temperature was  $104^{\circ}$  in the rectum, though the surface was with difficulty kept warm; on the eighth day the rectal temperature was  $103^{\circ}$ , after which a gradual diminution occurred; the child died on the fourteenth day. In the numerous cases of serous or choleraic diarrhœa among children occurring last July and August, this way of noting the temperature was also of use in estimating the gravity of the seizures, and sometimes in prognosticating recovery. A very delicate infant, a fortnight old, with an attack of this kind, had a temperature of  $101^{\circ}$ , and for three days it was  $100^{\circ}5$  or more; on the fourth day there was a diminution to  $99^{\circ}2$ , and on the fifth, though the child seemed as ill as possible, and the returning urinary secretion was much mixed with blood, the temperature being  $98^{\circ}6$  on that day, and  $98^{\circ}4$  on the next, gave hopes of recovery, which the result justified.

The high temperature characterising the acute specific diseases, is as marked in cholera and diphtheria as in measles and scarlet fever, and in doubtful cases often becomes a trustworthy agent of diagnosis. In the anomalous cases of Scarlet fever likely to arise in an epidemic as widely diffused as the present, some of the doubtful cases might be recog-



nised by the thermometer, which otherwise would be in danger of being overlooked; and it is hardly too much to say that in this way fatal consequences have been arrested.

A child one year and a quarter old (Case 20) had been restless for two nights, and had an evanescent eruption supposed to be tooth-rash; the child was running about the room, pale, with no trace of rash, and apparently cheerful and cool; the temperature was  $102^{\circ}$  on the surface, and in the evening became  $103^{\circ}$ , the rectal temperature was  $104^{\circ}$ . Warmth and rest enabled the rash to reappear; there was slight throat affection at first, which afterwards became troublesome, and the illness was not over for two months.

In Diphtheria, valuable time is often lost from the first few days of high temperature being overlooked. In Scarlet fever the high temperature is so quickly followed by the rash, that the necessary care can at once be taken. In both, the period of illness as measured by temperature, is somewhat longer than has been stated; in mild cases pyrexia only lasts five days, in some the temperature begins to subside on the surface before the rash disappears, and frequently becomes considerably less when that has faded, yet it may continue to be as high, or higher, in the rectum for a day or two longer, and may not subside till the tenth or twelfth day, after which the existence of certain complications will send it up again. An important point can here be decided by temperature. If no kidney disease have been set up, or be now existent, albuminuria may continue in considerable quantity (apparently from the blood-state alone), without increase of temperature, whereas, the appearance of albuminuria has been marked by a considerable increase of temperature where there has been reason to suspect lesion of the kidney. In one instance (Case 24), casts of renal tubes were found in the urine when there was no albumen.

The period of incubation for scarlet fever is probably five days; it may be less: the longest period to my knowledge is eight days, in the case which follows. No marked temperature change has yet been detected until the day preceding the rash; there may have been a day or two

of heaviness noticed, with perhaps yawning, and even a period of low temperature; just before the more declared symptoms there is excitability or liveliness sometimes with a return of appetite, and it is often remarked how particularly well the child seems; this, of frequent occurrence before the illnesses of children, marks the commencement of the elevation of temperature. A boy (Case 21), æt.  $2\frac{1}{2}$  years, removed from an infected house for a week's quarantine would, on the eighth morning, have been pronounced unusually well, except that the axillary temperature, hitherto somewhat below, was found to be slightly above the normal; the bowels had not acted with the usual regularity, by night there was a high temperature, and before morning vomiting and diarrhœa, with tenesmus. The rash was fully out by noon, and that evening and next day the temperature of the surface was  $101^{\circ}$ , with a very full rash. On the fifth day, the skin, though still very red, had a temperature at noon of only  $98^{\circ}$ , while in the rectum it was  $101^{\circ}$ , and at night  $102^{\circ}$ . This temperature, with the same evening exacerbatation, continued till the eighth day: the subsidence was nearly complete on the twelfth day, when there remained only coryza. In a boy, seven years old, (Case 22), the highest axillary temperature was  $102^{\circ}\cdot5$  in the evening of the third day; next morning it was only  $99$ , but rose to  $101^{\circ}$  by four o'clock in the afternoon, the temperature in the rectum continuing to be nearly  $102^{\circ}$ . On the fifth and sixth days the morning temperature of the surface was just below  $99^{\circ}$ , that of the rectum over  $100$ , and in the evening  $101^{\circ}$ .

An evening exacerbation was found throughout the course of scarlet fever. In the case just given, on the eighth day a slight articular affection made the morning temperature  $101^{\circ}$  and the evening  $102^{\circ}\cdot8$ ; next day these were  $101^{\circ}\cdot2$  and  $103^{\circ}$  respectively. The morning temperature became  $99^{\circ}$ , and the evening  $101^{\circ}\cdot4$  the twelfth day; on the next, these were  $99^{\circ}$  and  $100^{\circ}\cdot3$ ; on the fifteenth,  $99^{\circ}$  and  $99^{\circ}\cdot7$ ; it was not till the sixteenth day that a temperature of  $98^{\circ}$  in the morning, and  $98^{\circ}\cdot5$  in the evening, corresponded with an apparent freedom from illness. Sponging the surface during

the very height of the rash in scarlet fever has not only proved a comfortable but a perfectly safe proceeding; at this time its effect in raising the surface temperature and in moderating that of the interior, is at least as great as in health. In a boy of six (Case 23) who had been delicate, the axillary temperature on the second day of the rash of scarlet fever was only  $99^{\circ}\cdot 1$ —it had been  $100^{\circ}$  the evening before—the rectal temperature was  $102^{\circ}$ ; the surface was sponged at eleven a.m., and before noon  $101^{\circ}$  was obtained in the axilla; the evening exacerbation was moderated by the same means. The rash continued to be quite as red, but gave less discomfort. Where the difference between the surface temperature and that of the anterior is great, this method might be more frequently adopted; where both are unduly elevated, and not controlled by full doses of quinine, resort might be had to the old remedy of cold affusion.

Scarlet fever, if not always as severe in infancy, may be thoroughly characterised at an early age. A girl (Case 24), *æ*t.  $1\frac{1}{2}$  years, had a full and vivid rash during the first week of illness, slight affection of the ear-passages in the second, and some desquamation of the renal epithelium, as well as of the skin, in the third.<sup>1</sup> The disease, in a severe form, proved fatal to an infant whose sister, *æ*t. 4 years, recovered with the loss of the cervical glands by sloughing; this accident also eventually proved fatal to a delicate girl of five years, who suffered convulsions with the first appearance of the rash.

The highest temperature noted during scarlet fever has been  $104^{\circ}\cdot 5$ , in a boy, *æ*t.  $9\frac{1}{2}$  years, on the third and fourth days of the illness; this may have been exceeded during the intervening night, but the next night, when there was active delirium,  $104^{\circ}$  could not be obtained on the surface. The temperature was  $103^{\circ}$  in this case till the eighth day,  $102^{\circ}$

<sup>1</sup> During the passage of these sheets through the press scarlatina has been met with, preceded by thrush, in an infant (Case 31) not quite four weeks old; the temperature at the height of the rash reached  $102^{\circ}$ ; it was subsiding on the fourth day before the rash had quite disappeared: a slight increase marked an affection of the ears; recovery perfect.



on the ninth and tenth, and in two days more became normal.

In Measles a temperature of  $104^{\circ}$  has been met with just before the height of the rash (Case 25) in a boy of seven years old, with slight delirium, but no other bad symptom. A boy of nine has much nocturnal delirium, with a temperature of  $104^{\circ}\cdot 1$  in the axilla; this was on the fifth day of illness, and at the height of the rash; the next day there was diarrhœa and a temperature of  $101^{\circ}$ . Another boy, æt. 12, the third day of illness has a temperature of  $104^{\circ}\cdot 6$  on the first appearance of the rash; there was diarrhœa, but very slight delirium; a full rash with subsidence of temperature, and favorable progress with great depression of temperature after the sixth day. A boy of five (Case 26) has  $103^{\circ}\cdot 5$  on the third day, before the rash is fully out; on the fourth, with a full rash, the temperature is  $102^{\circ}\cdot 4$ , quite a degree less than the day before the eruption was complete; the pulse also subsided from 140 to 120, the respirations 30 on both days, increased to 36 in the minute on the next day, when the temperature continued to be as high as  $102^{\circ}$ ; on the sixth day the temperature falls while the rash is at its fullest; and while still quite red on the seventh day, the temperature is only  $98^{\circ}$ , the convalescence being rapid and uninterrupted. In the elder boy (Case 25) some râles were heard at the base of the lung on the eighth day during the depression of temperature; these disappeared under the use of stimulants, and recovery was equally rapid.

Convulsions occurring before the appearance of the rash, proved fatal to a weakly boy six and a half years old. He is ill, and complains of his throat; on the second day the temperature is  $104^{\circ}\cdot 5$ , the convulsions begin towards night; next day death comes before there are any signs of the eruption. A sister, older, and two brothers, younger, go through measles favorably in the same house at the same time; six months after they are all carried off by diphtheria.

Convulsions occurred on the appearance of the rash, with recovery, in a stout boy one year and eight months old (Case 10) when convalescent from whooping cough, and troubled with

the last four molars at the gum. Measles having broken out in the family, this child was removed from the house, carefully isolated, and watched. Ten days afterwards a slight elevation of temperature ( $99^{\circ}$  in the axilla) was noted at night, by morning this was  $100^{\circ}$ , the cervical glands were perceptibly enlarged, the child was sickening and was restless at night; this would have been called the first day of the illness. On the next day, the second, there are spots of rash behind the ears and on the shoulders, the temperature is  $102^{\circ}\cdot6$ . On the third day, at eight a.m., the rash is full upon the face, at noon the body and legs are covered; once during this day the temperature reached  $104^{\circ}$ , the exact time of this observation not being recorded. Convulsions occur at two p.m., afterwards the rash is paler; next day the temperature is only  $99^{\circ}$ , but the day after it is again  $102^{\circ}$ ; and though the disease may have been interrupted at its height by the convulsions, this increase of temperature was aided by some amount of pulmonary congestion, which continued through the following day. Convalescence was satisfactory with a low temperature, which was  $98^{\circ}$  on the ninth day, and afterwards still lower, the pulse and respiration being accelerated and reverting to the infantile type for some weeks (*vide* page 8).

Measles possibly becomes contagious before the characteristic lesion of the skin is established. The skin instead of being as in scarlet fever among the earliest tissues to be affected, shows signs of the disease after the implication of the conjunctival, the pharyngeal, and Schneiderian membrane, and not always before that of the larynx and bronchi. A little girl (Case 27) six years old, the sister of the infant last mentioned, who was removed at the same time (November 5) has coryza a day or two without attracting much notice, and has more marked symptoms of measles one day earlier than he (November 14th), when she is sick in the morning and delirious at night; the spots appearing but faintly on the 15th. The temperature is  $103^{\circ}$ , the rash abundant. On the 16th, temperature  $102^{\circ}$ , the rash quite as full; 17th, temperature  $99^{\circ}\cdot2$ , the appetite returning; the pulse 104. It was 140 on the 15th;

respiration at the same time has advanced from 30 to 34 in the minute; there are some bronchial râles, the breathing continuing to be slightly accelerated, and the temperature a little above the usual for a day or two longer. Had the first symptoms been attended to, and the child sent to bed a day or two earlier, it is fair to expect that the ailment would have passed off more easily. Her elder brothers, who had measles, were much with her before the separation, which was effected on the day that they first showed the eruption; whether she caught it from them before the appearance of the rash or no, it is clear that the elder brothers caught the complaint from a boy who had not then the completely developed disease. The two brothers (Cases 25, 26) attended a day-school where this boy resided. He was dull, and kept in the class-room with them on Thursday, October 22nd; they were absent from school the two following days, and on their return, Monday, October 26th, were at once sent home because this boy was in bed with measles. On October 31st the eldest brother is seized with vomiting, but is better next day, when both boys take a long walk and seemed tired. On November 2nd the younger has fever and restlessness in the night, and some spots appeared on the face which were not visible next day, November 3rd; the temperature also subsided to  $98^{\circ}4$  in the axilla, but the pulse remained accelerated; both have the rash out on November 5th, and it is at its height on the 7th—the thermometric crisis occurring a day earlier in the elder boy. This is twelve days from the visit to the school, and as they were in the same class-room it is probable that they contracted the disease from him a day or two before.

Another case of this kind occurred at an excellent day-school under my observation. On March 2nd, 1868, a boy seemed dull at his lessons, and was kept in the class-room throughout the day instead of going home to his dinner as usual; the next day he stayed at home, and on the 4th was known to have measles. Many of the younger boys, from eight to ten years of age, who used this class-room, were either away ill or noticeably ailing on March 12th; one boy who only seemed dull at his lessons on that day had the rash



appearing on the 14th, and on the 16th it was at the height.

When exposure to the source of infection is more continuous a shorter time suffices for the development of the disease, and the period of incubation is then closely approximated to that necessary for the evolution of the rash after inoculation. Exactly this period (seven days) elapsed in one case, where a delicate girl (Case 28) was brought into its midst. This was on January 24th, 1865; on the 26th, there was headache, a slight elevation of temperature, no alteration of pulse; 27th, pulse quickened, elevation of temperature not so marked, conjunctivæ reddened; to keep in bed; 28th, throat red, small spots on temples, does not feel ill; 29th, the spots are slightly raised, not more numerous and not red, restless at night, and temperature higher; 30th, appearance of rash on the face and neck; 31st, rash characteristic, face swollen, chest and body generally spotted, arms and legs as much clear skin as coloured. February 1st, still red, temperature normal, no after consequences. The favorable progress of this case was probably owing to rest in bed during the early stages. Could the signs of ingress always be noted, some of the uncertainty in the appearance of the rash from the first to the sixth day of illness, and as to whether the disease declines on the fourth or seventh day, now found in the best accounts of the disease, would be removed. Moreover, the want of an earlier recognition is the great cause of the spread of the disease. In measles the ailment is frequently well nigh over before it comes under observation. Nearly a fortnight may elapse from the time of exposure to the fully-developed rash. The first temperature change may not be noticeable till five or six days after exposure to infection; then there remain seven days of illness, only five of which are markedly pyrexial. The thermometric crisis occurs just as the rash is at its height. Complication may delay the crisis and keep up the temperature for a few days; the sequelæ are associated with the subsequent low temperature.

Small-pox, by inoculation is developed on the eighth day; taken by infection it does not appear on the skin till the

fourteenth, after two or more days of sharp illness. In one case of a young girl elevation of temperature was noted four days beforehand, this reached  $105^{\circ}2$  the evening before the rash was thrown out. The illness proved fatal.

Vaccination; after a temporary depression of temperature a continuous rise commences on the fourth and fifth days; this suddenly increases on the eighth day, and as suddenly falls. Afterwards the local process may continue active, but the disease is over. There is, too, a tendency to a low temperature afterwards, and this actually accompanies any subsequent eruption, such as the vaccineous roseola.

Varicella once only has been known to begin with convulsions, and this in a weakly boy four years old; the convulsions occurred on the day preceding the eruption, there were no other bad symptoms. The pyrexia often attains a considerable elevation in this disease before the eruption is completed. A healthy, strong lad, twelve years of age, after two or three days' feeling of illness is found with a temperature of  $102^{\circ}$ , which increases at night and is attended with delirium; the next day some spots of varicella appear, on the third day they are numerous on the back and belly; the temperature in the axilla was at or near  $99^{\circ}$  from this to the eighth or ninth day, the spots continuing to be red; some of them dried up on the seventh day, when there was slight conjunctivitis. On the tenth day the spots had disappeared, the usual depression of temperature followed; on the eleventh day only  $95^{\circ}$  could be obtained in the axilla, the thermometer kept under the tongue with elosed lips for two minutes only reached  $97^{\circ}5$ . In a case of doubtful diagnosis in a weakly young woman the persistence of a temperature of  $99\frac{1}{2}^{\circ}$  at the end of the third week seemed to point to variola rather than varicella, though the case on either supposition must have been anomalous.

Mumps comes on with a marked elevation of temperature; it has been found as high as  $103^{\circ}$  in a child (Case 29)  $1\frac{1}{4}$  year old, just before the greatest swelling of the parotid; there is often a subsidence of temperature by the time the child comes under observation or shortly after, the swelling continuing after the fever (sometimes very slight) is passed: so

that sometimes a boy will complain, with reason, that this is worse than other of his infantile disorders in that he feels hungry but cannot eat. The period of incubation is a long one, probably a fortnight.

Hooping-cough presents more difficulties in tracing thermometrically: its period of incubation may be nearly seven days. A girl, *æt.* 12, returns home July 25th, while her five younger sisters all have hooping-cough. On August 2nd she has large bronchial rhonehus and the hoop. The diagnosis of hooping-cough in its early stage from influenza or bronchitis in children must be always difficult. There is the same elevation of temperature, and the only point of differentiation to be offered provisionally, is the undue excitement and quickening of the pulse in proportion to the respiration; this point, common to all diseases of the class, may be noticed before, or sometimes with the first cough, often long before the first hoop, and at the same time a rise of almost a degree of temperature may be noticed.<sup>1</sup> Purpura and some other dyscrasie quicken the pulse, but do not elevate the temperature. Bronchitis, which elevates the temperature, unduly accelerates the respiration. Hooping-cough is also attended with a quickened respiration after the first day or two of illness; when the disease is fully established any rise of temperature then occurring must be referable to pulmonary complication, in every case where this has been noted it was owing, and in proportion to, the lesion of lung present; there may be serious impediment to respiration, as in the apneumotosis so well inquired into by Dr. Graily Hewitt, without at first producing a corresponding temperature change. When there is much impediment to respiration convulsions are imminent, and it is not too much to say that convulsions so frequently fatal in hooping-cough are always owing to the pulmonary implication. There may at the time be a greater elevation of temperature than the state of the

<sup>1</sup> In these diseases, at this stage, the use of sulphurous acid spray on Dr. Dewar's plan is to be recommended. Next to the power of a more early recognition of infectious diseases, some means of arresting them in their earliest stage is necessary to their extirpation.



lung generally produces, but for the relief of this condition, it is the respiration and not the nervous system that is first to receive attention.

A child (Case 30) eleven months old, eight or ten days with hooping-cough, is suddenly febrile, with increase of cough at night, and short breath; next day convulsions occur, a leech-bite on the temple had been bleeding some hours when the child came under observation; there was great pallor, and the fontanelle was depressed. Pneumonia, not far advanced, existed in the left lung. Before giving an enema of weak extract of meat and brandy, the temperature in the rectum was found to be  $103^{\circ}6$ ; next day the temperature in recto was  $104^{\circ}$ , the day after  $103^{\circ}$ , after which the pneumonia disappeared; the chest-walls were not collapsed; and now, though the respiration was relieved, the convulsions would sometimes continue for more than an hour. It was noticed that a convulsion took the place of a hoop, and was kept up by spasm of the glottis. The child was then held face downwards over a basin, cold water poured on to the nape and vertex, air was soon drawn into the chest, mucus expelled from the mouth, the attack thus cut short, and the child made a good recovery.

A parallel is again here noticeable between the convulsions produced by this condition in the infant, and the delirium so constantly met with in the adult, where there is either sudden congestion of the lung or pneumonia. The great loss of blood in this case did not affect the pneumonia, though in its early stage; and what is still more worthy of note is that it did not in any way tend to reduce the pathognomonic temperature; indeed, this was somewhat higher than usual, though at the same time the system seemed nearly exsanguine.

There is one form of catarrh essentially infectious, which comes on with an elevation of temperature; this often amounting in young children to  $100^{\circ}$ , before any complication, except slight enlargement of the cervical glands, can be detected; this has been found associated with influenza, and herpetic sore throat in different members of the same family,

and is difficult to distinguish at first from the onset of the exanthemata or of hooping-cough.

The spasmodic cough, occurring at night in children of low nutrition, or suffering from teething, is readily distinguishable by the low temperature from the ingress of hooping-cough; a point of some importance among young children.

Thrush, or muguet, has been found associated with either extreme of temperature; in the one condition (Case 3) pointing to the want of suitable nutrition, with a good prospect of recovery, which would be less hopeful were the temperature to rise; in the other the prospect of recovery varies with the nature of the illness and the condition of the patient. At the commencement of a malady (Case 31) its presence need not prejudice the prognosis, and points then, as in cases where but little temperature change is met with, to the removing such articles of diet as the child cannot digest, and to the neutralizing the acid state of the mouth existing, when the vegetation and increase of the *Oidium albicans*, of which the white spots consist, is impossible.

Bronchitis may cause an elevation of temperature to  $100^{\circ}$ , and reduce the pulse ratio below three to one. In children over two years of age the pulse and respiration ratio may, as in adults, be a guide to pulmonary congestion or pneumonia, of which latter state the ratio of two to one is no doubt pathognomonic; but in infants, little more than the extreme disturbance of this relation can be made out. Besides the physical signs of these disorders, we have for our guidance the greater elevation of temperature, which, if a small part of the lung tissue be implicated, will often rise to  $103^{\circ}$ , or higher. As high a degree of temperature may exist for a day or two in idiopathic erup. In erupal diphtheria the temperature may or may not be so high, but it continues near  $100^{\circ}$  for a much longer period, possibly to the tenth or twelfth day, even in extreme conditions of apnoea.

Meningitis in an infant four months old, had with the earliest convulsive twitches a temperature of  $100^{\circ}$ ; this was  $101^{\circ}$  before evening, next morning it was  $103^{\circ}6$  in the axilla and increased to  $104^{\circ}$ ; death on the third day.

In taking these observations, it is necessary that the thermometer should have a small bulb, and that it should be completely covered by, and in contact with the surface where it is applied. Except in very young infants the axilla is the most convenient place, and the thermometer is best introduced from behind; on raising the arm two axillary folds are seen, the thoracic one should receive the bulb of the instrument, and the arm be then turned and held down for two or three minutes; in this way a temperature may often be obtained within half a degree of that of the interior of the body. In the folds of skin around the neck of a well-nourished infant a similar result may be obtained; indeed, a fold of skin sufficient to cover the bulb of the thermometer at any part of the surface which has not been unduly exposed, will afford useful indications,—even the readiness with which the temperature is obtained may be of some diagnostic value.

In conclusion, it is hoped that these observations may be found to have a practical relation to the health of infants; and that this method of observing may prove a definite aid to our means of investigating their diseases; while the facts brought together may not be without value, as affording elements of comparison, to other observers.

